19. THE PROCESS OF MOULTING AND THE NUMBER OF INSTARS IN THE TIGER BEETLE, *CICINDELA CANCELLATA* DEJ. (COLEOPTERA : CICINDELIDAE)

(*With a text-figure*)

Cicindela cancellata Dej. is a tiger beetle which is widely distributed in India. Its larvae live inside burrows in the soil and therefore it is very difficult to observe all the details of its life-history under natural environmental conditions. The authors have been rearing this species in the laboratory in specially designed glass rearing jars. As a few of the larvae excavate their burrows accidentally, along the wall of the rearing jar, it is possible to observe through the glass wall the process of moulting in the larva inside the burrow. This paper gives an account of the process of moulting and also the result of an indirect investigation into the number of larval instars in this beetle by the application of Dyar's Law.

The process of moulting. The larva, after a period of active feeding and just before the moult, blocks the opening of the burrow with sand, stops feeding, settles down at the bottom of the burrow and becomes inactive. At this stage, the abdomen of the larva, which at other times is light brown or grey in colour, becomes yellowish. The larva occasionally wriggles its body rapidly in an undulating fashion. Frequently, the body is suddenly bent ventralwards in a snapping manner.

Moulting takes place during the night. As a result of the characteristic movements of the body and other internal factors, the larval cuticle splits along the ecdysial lines which are present on the head and the thorax. On the head, splitting of cuticle takes place along the short coronal suture and the arms of the frontal suture which are relatively long and slightly wavy, diverging widely and terminating anteriorly at the dorsal edges of the antennal sockets. In the thorax, the cuticle splits along the mid-dorsal line of weakness or ecdysial line. The pattern of ecdysial splitting of the cuticle is clearly seen in the exuviae collected from the burrows.

The number of instars.—Dyar (1890)[1] stated that in lepidopteran larvae, the width of the head capsule increases in a regular geometric progression through successive instars, by a ratio of about 1·4. This principle which is known as Dyar's law, has been used successfully to determine the number of larval instars in some insects.

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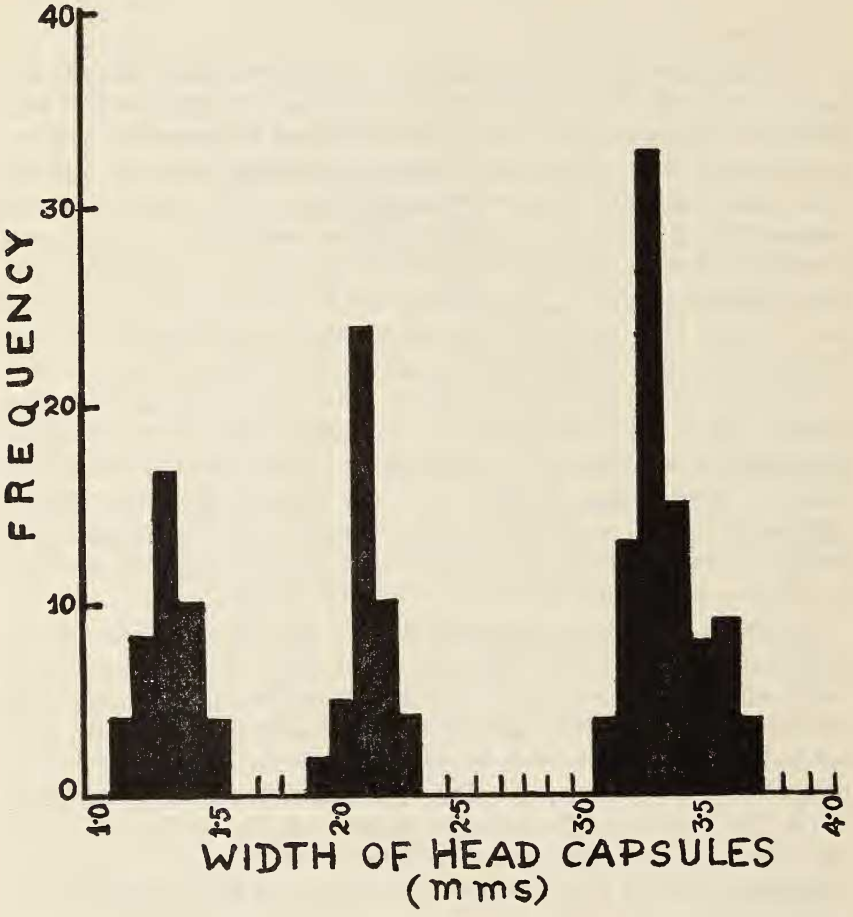
[1] DYAR, H. G. (1890) : The number of moults of Lepidopterous larvae. *Psyche*. 5 : 420-422.

A large number of larvae of *Cicindela cancellata* in the various stages of growth, were collected from the field and from the rearing jars in the laboratory. The measurements of the width of their head capsules were recorded and the frequency distribution of the various values was studied. The text-figure gives the results in the form of an histogram.



Histogram of the width of head capsules of the larvae of *Cicindela cancellata*.

The histogram clearly shows that the width of head capsules fall under three distinct and discontinuous classes, indicating that there are three larval instars in the life cycle of *Cicindela cancellata*. The mean width of head capsules of the three instars are, 1·31, 2·12, and 3·36 millimetres respectively. The growth ratio between the first and second instar is 1·63 and that between the second and the final instar is 1·59. It

is seen that the growth ratio between successive instars is approximately constant.

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20. NEW RECORDS OF HYMENOPTEROUS PARASITES OF PEA LEAFMINER *PHYTOMYZA ATRICORNIS* MEIGEN (DIPTERA : AGROMYZIDAE)

The pea leafminer *Phytomyza atricornis* Meigen is the most common and widespread leafminer throughout the world. The larva of this pest is polyphagus and attacks a large number of plants belonging to several natural orders. According to Trehan & Sehgal (1963), the larva feeds indiscriminately on pallisade and spongy mesenchymatous tissues but never consumes the entire tissues between the upper and lower epidermis and the endodermal cells containing starch are largely avoided. Ahmad & Gupta (1941), while studying the biology of this pest on pea, reared an Eulophid, *Solenotus* sp. from its larval stages. Narayanan *et al.* (1956) reared an ectoparasite *Solenotus* sp., an endoparasite, *Rhopalotus* sp. and an unidentified braconid on the larval stages of this host fly. Only recently Odak *et al.* (1968) have recorded *Opius* sp. (Braconidae) and *Neochrysocharis* sp. (Eulophidae) as parasites of *P. atricornis* from Gwalior (India). The present study was, thererfore, undertaken to investigate parasites of this leafminer in the Ranchi area and leaves of pea (*Pisum sativum* Linn.) were collected. The following six hymenopterous insects emerged from the leafmines.

1. *Chrysocharis* sp. (Eulophidae)

Thompson (1943, 1954) has recorded *Chrysocharis* sp., *C. elongatus* and *C. syma* from New Zealand, Yugoslavia and England respectively, as parasites of this leafminer.

2. *Tetrastichus* sp. (Eulophidae).
3. *Cirrospilus* sp. (Eulophidae).
4. *Opius* sp. ? *phaseoli* Fischer (Braconidae).
5. *Opius* sp. ? *lantanae* Bridw. (Braconidae).
6. *Sphegigaster* sp. (Pteromalidae).